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(54) LUBRICATING OIL COMPOSITION

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a lubricating oil particularly desirably used in a vehicle equipped with a diesel engine using a low-sulfur-content hydrocarbon fuel.

SOLUTION: The lubricating oil composition is one prepared by dissolving or dispersing (a) 0.01-0.3% (in terms of the nitrogen content) succinimide ashless dispersant; (b) 0.1-1% (in terms of the sulfuric acid ash) metal-containing cleaning agent having a sulfur content of 3.5% or lower and a total base value of 10-350 mgKOH/g; (c) 0.01-0.1% (in terms of the phosphorus content) zinc dialkyldithiophosphate; (d) 0.002-0.05% (in terms of the phosphorus content) phosphoric ester, thiophosphoric ester, dithiophosphoric ester, a or phosphorous ester; and (e) 0.01-5% antioxidant being a phenol compound, an amine compound, or a molybdenum compound, wherein the (c)/(d) ratio is 20:1 to 1:1 by a phosphorus content ratio, the sulfuric acid ash content is 0.1-1%, the phosphorus content is 0.01-0.1%, the sulfur content is 0.01-0.5%, the chlorine content is at most 40 ppm, and the content of the organic acid metal salt in the metal-containing cleaning agent is 0.2-7%.

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CLAIMS

[Claim(s)]

[Claim 1] To base oil of 0.2 or less % of the weight of sulfur contents which consist of mineral oil and/or synthetic oil of lubricating oil viscosity, at least, In ash-free nature powder medicine which is a alkenyl, alkyl amber acid imide, or its derivative, based on full weight of a constituent, b sulfur content 0.01 to 0.3% of the weight with a nitrogen content reduced property at 3.5 or less % of the weight. The total basicity 10 - a metal content cleaning agent of 350 mgKOH/g with a sulfuric acid ash reduced property 0.1 to 1 % of the weight, Dialkyl phosphorodithioate zinc with a phosphorus content reduced property c) 0.01 to 0.1 % of the weight, d) Phosphoric ester, thiophosphoric ester, dithiophosphate ester, And at least a kind of Lynn content ester chosen from a group which consists of phosphite with a phosphorus content reduced property as 0.002 to 0.05 % of the weight, and an e antioxidant, At least a kind of compound chosen from a group which consists of a phenolic compound, an amine compound, and a molybdenum compound, Dissolve or distribute in quantity of 0.01 to 5 % of the weight **, and a ratio of dialkyl phosphorodithioate zinc and Lynn content ester is in the range of 20:1-1:1 by a phosphorus content ratio of the former versus the latter, and a sulfuric acid ash content based on full weight of a constituent 0.1 to 1% of the weight of a range, A lubricating oil composition which a range whose phosphorus content is 0.01 to 0.1 % of the weight, a range whose sulfur content is 0.01 to 0.5 % of the weight, and a chlorine content are below 40 weight ppm, and is characterized by organic acid metal salt further contained in a metal content cleaning agent existing in 0.2 to 7% of the weight of the range in a constituent.

[Claim 2] c) The lubricating oil composition according to claim 1 which has a ratio of dialkyl phosphorodithioate zinc of an ingredient, and the Lynn content ester of d ingredient in the range of 10:1-2:1 by a phosphorus content ratio of the former versus the latter.

[Claim 3] d) The lubricating oil composition according to claim 1 or 2 whose Lynn content ester of an ingredient is triester which has an alkyl group and/or an aryl group.

[Claim 4] a) A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 3 whose chlorine contents ash-free nature powder medicine of an ingredient is ash-free nature powder medicine below 40 weight ppm.

[Claim 5] a) Ash-free nature powder medicine of an ingredient a polybutenyl amber acid anhydride in which at least 50% was obtained by making highly reactive polybutene and a maleic anhydride which have methylvinylidene structure react by a thermal reaction method, The lubricating oil composition according to claim 4 which is amber acid imide produced by making react to polyalkylene polyamine, or its derivative.

[Claim 6] a) A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 5 which have a ratio of a nitrogen content originating in ash-free nature powder medicine of an ingredient, and a sulfuric acid ash content originating in a metal content cleaning agent of b ingredient in the range of 1:1-1:20 by a weight ratio of the former versus the latter.

[Claim 7] e) A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 6 whose antioxidants of an ingredient are a hindered phenolic compound and/or a diarylamine compound.

[Claim 8] The lubricating oil composition according to claim 7 which furthermore carries out 30-

1000 weight ppm content of the molybdenum content compound with a molybdenum content reduced property as an ingredient.

[Claim 9]A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 8 which have a sulfuric acid ash content based on full weight of a constituent in 0.1 to 0.6% of the weight of a range.

[Claim 10]A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 9 in a range whose sulfur content based on full weight of a constituent is 0.01 to 0.35 % of the weight.

[Claim 11]Base oil is the base oil of the mineral oil origin of lubricating oil viscosity, and a viscosity index 120 or more. A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 10 whose evaporation losses are an oil 0.01 or less % of the weight and whose aromatic content 15 or less % of the weight and a sulfur content are 10 or less % of the weight, or a mixed oil which contains this oil 10% of the weight or more.

[Claim 12]A lubricating oil composition given in a paragraph of either of the claims 1 thru/or 11 whose SAE viscosity grades are either 0W30, 5W30, 10W30, 0W20 and 5W20.

[Claim 13]How to make lubricous a diesel power plant by which an exhaust system was equipped with a particulate filter and/or an emission gas purifying catalyst using a lubricating oil composition given in a paragraph of either of the claims 1 thru/or 12.

[Claim 14]To base oil of 0.2 or less % of the weight of sulfur contents which consist of mineral oil and/or synthetic oil of lubricating oil viscosity, at least, Ash-free nature powder medicine which is alkenyl, alkyl amber acid imide, or its derivative, At least a kind of antioxidant chosen from a group which consists of a metal content cleaning agent, a phenolic compound, an amine compound, and a molybdenum compound, Dialkyl phosphorodithioate zinc and phosphoric ester, thiophosphoric ester, A lubricating oil composition where at least a kind of Lynn content ester chosen from a group which consists of dithiophosphate ester and phosphite is added and which has a ratio with dialkyl phosphorodithioate zinc:Lynn content ester in the range of 20:1-1:1 by a phosphorus content ratio.

[Claim 15]The lubricating oil composition according to claim 14 in a range whose phosphorus content is 0.01 to 0.1 % of the weight.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a lubricating oil composition useful to the lubrication of internal-combustion engines, such as a diesel power plant, a gasoline engine or an engine that uses wood ether as fuel, and a gas engine. In more detail this invention A low ash content, a low phosphorus content, a low-sulfur content, And though it is a low-salt matter content, it excels in an elevated-temperature detergency and abrasion preventing performance, and there are few adverse effects to a particulate filter or an emission gas purifying catalyst, and it is related with the internal-combustion-engine-oil constituent which can respond also to the regulation of exhaust gas near future operation is predicted to be enough. The car by which especially this invention uses the hydrocarbon system fuel of about 0.01 or less % of the weight of sulfur contents as fuel for a run, It is related with the eco-friendly internal-combustion-engine-oil constituent especially used suitably in the diesel-power-plant loading vehicle provided with the emission gas purge (especially a particulate filter or an emission gas purifying catalyst).

[0002]

[Description of the Prior Art]In the internal-combustion engine, especially the diesel power plant, the measure for reducing the environmental pollution by emission gas ingredients, such as a particulate (granular material) and NO_x , has been important SUBJECT. As the measure, it is leading to equip a car with emission gas purges, such as a particulate filter and an emission gas purifying catalyst (oxidation or reduction catalyst). When the conventional internal combustion engine oil is used for the car equipped with such an emission gas purge, Although the soot adhering to a particulate filter is removed by oxidation and combustion, the problem that a filter carries out clogging with a metallic oxide, sulfate, carboxylate which were generated by combustion has produced it.

[0003]Existence of the sulfur content in fuel leads to mixing of sulfuric acid to the inside of emission gas, or sulfate, if especially the adverse effect to a purifying catalyst is taken into consideration, it is necessary to reduce it as much as possible, and it is thought that he will follow the sulfuric content reduction of fuel much more in the near future. If gas oil for diesel-power-plant loading cars is taken for an example, the content sulfur content will be predicted to be what is reduced from about 0.05% of the weight of the present sulfur content to till around 0.01 or less % of the weight and 0.001 more % of the weight. If the sulfuric content reduction of fuel progresses, the addition of the metal system cleaning agent (metal content cleaning agent) in the lubricating oil needed in order to neutralize sulfuric acid etc. can be reduced. On the other hand, the part burns and is discharged as emission gas at the same time a lubricating oil is lubriciously used in an engine. Therefore, naturally it is more desirable for a part for metal and sulfur content in a lubricating oil to also make it as low as again possible. It is preferred to also reduce a part for Lynn and sulfur content in a lubricating oil on the measure against degradation of a catalyst. When the possibility of generating of dioxins is taken into consideration, it is preferred to also reduce a part for chlorine in a lubricating oil as much as possible.

[0004]Conventionally the diesel internal-combustion engine used with a car, construction machinery, a dynamo, etc., It is common that sulfur content is operated using about 0.05% of the

weight or more of fuel (gas oil and fuel oil), and as a lubricating oil for diesel power plants, usually, about 1.3 to 2 % of the weight of sulfuric acid ash, about 0.3 to 0.7 % of the weight of sulfur content, and Lynn — about 0.1 to 0.13% of the weight per part, when ** is many, it has been used. More than 50 – 100 weight ppm of a part for chlorine was also common.

[0005]In JP,2002-53888,A, a low ash content, a low phosphorus content, a low-sulfur content, As an internal-combustion-engine-oil constituent in which it is a low-salt matter content, and the adverse effect to a particulate filter, an oxidation catalyst, etc. shows a good elevated-temperature detergency, and can respond to the future regulation of exhaust gas enough few, To the base oil of 0.1 or less % of the weight of sulfur contents which consist of mineral oil and/or synthetic oil, at least, Based on the full weight of a constituent, the ash-free nature powder medicine which is a alkenyl, alkyl amber acid imide, or its derivative with a nitrogen content reduced property 0.01 to 0.3 % of the weight, In a sulfur content, the total basicity 10 – the metal content cleaning agent of 350 mgKOH/g with a sulfuric acid ash reduced property at 3 or less % of the weight b) 0.1 to 1 % of the weight, Dialkyl phosphorodithioate zinc with a phosphorus content reduced property c) 0.01 to 0.1 % of the weight, The phenolic compound of d antioxidantizing nature and/or the amine compound of antioxidantizing nature And 0.01 to 5 % of the weight, It dissolves or distributes in the amount of **, is in the range whose sulfuric acid ash content is 0.1 to 1% of the weight of a range and whose phosphorus content is 0.01 to 0.1 % of the weight, and the range whose sulfur content is 0.01 to 0.3 % of the weight based on the full weight of a constituent, and a chlorine content is 40 ppm or less, The lubricating oil composition, wherein 0.2 to 7 % of the weight of organic acid metal salt furthermore contained in a metal content cleaning agent exists in a constituent is indicated.

[0006]

[Problem(s) to be Solved by the Invention]This inventions are a low ash content, a low phosphorus content, a low-sulfur content, and a low-salt matter content compared with the lubricating oil composition used conventionally. The purpose is to provide the internal-combustion-engine-oil constituent which shows the elevated-temperature detergency and abrasion preventing performance where the adverse effect to emission gas purges, such as a particulate filter and an emission gas purifying catalyst, was reduced and, which were excellent, and can respond to the future regulation of exhaust gas enough.

[0007]

[Means for Solving the Problem]Although it is generally known for a researcher and an engineer who further development of a lubricating oil composition, Mere reduction in the ash of an internal-combustion-engine-oil constituent, low-phosphorus-izing, and a sulfuric content reduction meant reduction of an addition of a metal system cleaning agent generally used to a lubricating oil composition, and dithiophosphate zinc, and this has brought about a fall of an elevated-temperature detergency or oxidation stability. Reduction of dithiophosphate zinc brings about a fall of abrasion preventing performance.

[0008]a result to which this invention person repeated research wholeheartedly — an ash-free system specific to a lubricating oil composition — adding an antioxidant. And organic acid metal salt (what is called a soap component or a soap ingredient) contained in a metal system cleaning agent (metallic component content cleaning agent) to make it exist in quantity of a specific range in addition, by adding still more specific Lynn content ester in the specific range, It found out that it was maintainable on a level also with high abrasion preventing performance, without reducing an elevated-temperature detergency and oxidation stability. That is, by using combining specific Lynn content ester by dialkyl phosphorodithioate zinc and a specific ratio, an obtained lubricating oil composition finds out excelling in both sides of an elevated-temperature detergency and abrasion preventing performance, and reaches this invention.

[0009]Therefore, this invention to base oil of 0.2 or less % of the weight of sulfur contents which consist of mineral oil and/or synthetic oil of lubricating oil viscosity at least, In ash-free nature powder medicine which is a alkenyl, alkyl amber acid imide, or its derivative, based on full weight of a constituent, b sulfur content 0.01 to 0.3% of the weight with a nitrogen content reduced property at 3.5 or less % of the weight. The total basicity 10 – a metal content cleaning agent of

350 mgKOH/g with a sulfuric acid ash reduced property 0.1 to 1 % of the weight, Dialkyl phosphorodithioate zinc with a phosphorus content reduced property c) 0.01 to 0.1 % of the weight, d) Phosphoric ester, thiophosphoric ester, dithiophosphate ester, And at least a kind of Lynn content ester chosen from a group which consists of phosphite with a phosphorus content reduced property as 0.002 to 0.05 % of the weight, and an e antioxidant, At least a kind of compound chosen from a group which consists of a phenolic compound, an amine compound, and a molybdenum compound, Dissolve or distribute in quantity of 0.01 to 5 % of the weight **, and a ratio of dialkyl phosphorodithioate zinc and Lynn content ester is in the range of 20:1-1:1 by a phosphorus content ratio of the former versus the latter, and based on full weight of a constituent, A range whose sulfuric acid ash content is 0.1 to 1% of the weight of a range and whose phosphorus content is 0.01 to 0.1 % of the weight, A range and a chlorine content whose sulfur content is 0.01 to 0.5 % of the weight are below 40 weight ppm, and it is in a lubricating oil composition, wherein organic acid metal salt further contained in a metal content cleaning agent exists in 0.2 to 7% of the weight of the range in a constituent.

[0010]This invention to base oil of 0.2 or less % of the weight of sulfur contents which consist of mineral oil and/or synthetic oil of lubricating oil viscosity at least, Ash-free nature powder medicine which is alkenyl, alkyl amber acid imide, or its derivative, At least a kind of antioxidant chosen from a group which consists of a metal content cleaning agent, a phenolic compound, an amine compound, and a molybdenum compound, Dialkyl phosphorodithioate zinc and phosphoric ester, thiophosphoric ester, It is also in a lubricating oil composition where at least dithiophosphate ester and a kind of Lynn content ester chosen from a group which consists of phosphite are added and which has a ratio with dialkyl phosphorodithioate zinc:Lynn content ester in the range of 20:1-1:1 by a phosphorus content ratio.

[0011]A lubricating oil composition of this invention can be especially used advantageously, when making lubricous a diesel power plant by which an exhaust system was equipped with a particulate filter and/or an emission gas purifying catalyst.

[0012]As for a ratio (the former versus latter) of dialkyl phosphorodithioate zinc of c ingredient, and the Lynn content ester of d ingredient, in a lubricating oil composition of this invention, it is preferred that it is in the range of 10:1-2:1 by a phosphorus content ratio. As for the Lynn content ester of d ingredient, it is preferred that it is triester which has an alkyl group and/or an aryl group.

[0013]In a lubricating oil composition of this invention, ash-free nature powder medicine of a ingredient, It is preferred that a chlorine content is the ash-free nature powder medicine below 40 weight ppm (especially below 30 weight ppm), A polybutenyl amber acid anhydride especially produced by at least 50% making highly reactive polybutene and a maleic anhydride which have methylvinylidene structure react by a thermal reaction method, It is preferred that they are amber acid imide produced by making react to polyalkylene polyamine or its derivative. As for a ratio (former: latter) of a nitrogen content originating in ash-free nature powder medicine of a ingredient, and a sulfuric acid ash content originating in a metal content cleaning agent of b ingredient, it is preferred that it is in the range of 1:1-1:20 by a weight ratio.

[0014]In a lubricating oil composition of this invention, as for an antioxidant of e ingredient, it is preferred that they are a hindered phenolic compound and/or a diarylamine compound, and it is still more preferred to carry out 30-1000 weight ppm content of the molybdenum content compound with a molybdenum content reduced property.

[0015]In a lubricating oil composition of this invention, as for a sulfuric acid ash content based on full weight of a constituent, it is preferred that it is in 0.1 to 0.6% of the weight of a range, and, as for a sulfur content based on full weight of a constituent, it is preferred that it is in 0.01 to 0.35% of the weight of a range.

[0016]In a lubricating oil composition of this invention, base oil is the mineral oil system base oil (base oil of the mineral oil origin) of lubricating oil viscosity, It is preferred that a viscosity index is [a sulfur content] an oil 0.01 or less % of the weight and whose aromatic content are 15 or less % of the weight, and 120 or more and an evaporation loss are 10 or less % of the weight, or a mixed oil which contains this oil 10% of the weight or more. And as for a lubricating oil composition of this invention, it is preferred to add a viscosity index improver and to use in SAE

viscosity grades if needed, as multigrade engine oil of 0W30, 5W30, 10W30, 0W20, or 5W20.

[0017]

[Embodiment of the Invention][Base oil] As base oil in the lubricating oil composition of this invention, mineral oil and synthetic oil of 2 - 50 mm²/s are usually used for the kinetic viscosity at 100 **. Although there is no restriction in particular about the kind of mineral oil and synthetic oil, and other descriptions, a sulfur content needs to be 0.2 or less % of the weight as base oil. However, as for the sulfur content of base oil, it is desirable that it is 0.1 or less % of the weight, it is desirable that it is 0.03 or less % of the weight, and it is desirable that it is especially 0.005 or less % of the weight.

[0018]As for mineral oil system base oil, it is desirable to process a mineral-lubricating-oil fraction, combining suitably disposal methods, such as solvent refining or hydrogen treatment. Especially an advanced hydrorefining (hydrocracking) oil (for example, oil whose viscosity index is 15 or less % of the weight and 0.01 or less % of the weight and whose aromatic content the sulfur content of 120 or more and an evaporation loss (ASTM D5800) is 10 or less % of the weight) is used preferably. Or the mixed oil which contains such a hydrocracking oil 10% of the weight or more is also used preferably. The oil of a high viscosity index (a viscosity index is especially 140-150 140 or more) made from the process of isomerization and hydrocracking by using as a raw material the synthetic wax compounded from mineral oil system slack wax (slack wax) or natural gas is also contained in this hydrocracking oil. A hydrocracking oil has a part for low sulfur, low evaporativity, and preferred carbon residue content on the purpose of points, like it is few to this invention.

[0019]The Poly alpha olefin which is a polymer of the alpha olefin of the carbon numbers 3-12 as synthetic oil (synthetic oil base oil), for example, The dialkyl diester which is ester of the dibasic acid represented by dioctyl sebacate, such as sebacic acid, azelaic acid, and adipic acid, and alcohol of the carbon numbers 4-18, The polyol ester which is ester of 1-trimethylolpropane, pentaerythritol, and the monobasic acid of the carbon numbers 3-18, the alkylbenzene which has an alkyl group of the carbon numbers 9-40, etc. can be mentioned. Generally, since there is little generation of carbon residue or soot once synthetic oil is excellent in oxidation stability and heat resistance and burns excluding sulfur content substantially, it is preferred to this lubricating oil composition.

[0020]Although mineral oil system base oil and constructional system base oil can be used alone, respectively, they can also be used by request combining two or more sorts of mineral oil system base oil, or two or more sorts of constructional system base oil. It can also use by request combining mineral oil system base oil and constructional system base oil at an arbitrary rate.

[0021][Additive agent]

a) The alkenyl derived from polyolefine as ash-free nature powder medicine in the lubricating oil composition of ash-free nature powder medicine this invention, alkyl amber acid imide, or its derivative is used. Based on the full weight of a constituent, the addition is a nitrogen content reduced property, and is in 0.01 to 0.3% of the weight of the range. Typical amber acid imide can be obtained by the reaction of the amber acid anhydride replaced by the alkenyl or alkyl group of the amount of polymers, and polyalkylene polyamine containing an average of 4-10 nitrogen atoms (preferably 5-7 pieces) per molecule. As for the alkenyl or alkyl group of the amount of polymers, it is preferred that a number average molecular weight is about 900 to 5000 polyolefine, and it is preferred that it is especially polybutene.

[0022]In many cases, the chlorinating method for using chlorine is used in the process of obtaining a polybutenyl amber acid anhydride by the reaction of polybutene and an anhydrous mallein. However, in this method, although conversion is good, a result to which a lot of chlorine (for example, about 2000 ppm) remains in an amber acid imide final product is brought. On the other hand, in the thermal reaction method do not use chlorine, the chlorine which remains into a final product can be pressed down on a very low level (for example, 40 ppm or less). If highly reactive polybutene (that in which at least about 50% has methylvinylidene structure) is used compared with conventional polybutene (beta-olefin structure is a subject), conversion improves also by a thermal reaction method and it is advantageous. In this case, since unreacted

polybutene decreases, a dispersing agent with high active component (amber acid imide) concentration can be obtained. Therefore, preferably, after obtaining a polybutenyl amber acid anhydride by a thermal reaction method using highly reactive polybutene, this polybutenyl amber acid anhydride is made to react to number of average nitrogen atoms 4-10 piece (per molecule) polyalkylene polyamine, and amber acid imide is manufactured. The amber acid imide can make it able to react to boric acid, alcohol, aldehyde, ketone, alkylphenol, cyclic carbonate, organic acid, etc. further, can be made into what is called denaturation amber acid imide, and can be used. Especially the boron content alkenyl (or alkyl) amber acid imide obtained at a reaction with boric acid or a boron compound is advantageous in respect of thermal oxidation stability.

[0023] Although the alkenyl, alkyl amber acid imide, or its derivative is contained as an essential ingredient, the lubricating oil composition of this invention also combines suitably the ash-free nature powder medicine of an alkenyl benzylamine system or an alkenyl amber acid ester system which is ash-free nature powder medicine other than these, and is used.

[0024] b) In the lubricating oil composition of metal system cleaning agent this invention, the total basicity 10 - the metal system cleaning agent of 350 mgKOH/g are used in 0.1 to 1% of the weight of the range with a sulfuric acid ash reduced property as a metal system cleaning agent (metal content cleaning agent) with 3.5 or less % of the weight of sulfur contents. And the ratio (the former versus latter) of the nitrogen content originating in the above-mentioned ash-free nature powder medicine and the sulfuric acid ash content originating in a metal system cleaning agent has been in the range of 1:1-1:20 in the range of 1:2-1:15 preferably desirable especially by the weight ratio.

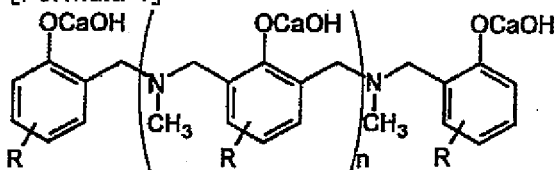
[0025] Generally as a metal system cleaning agent, sulfuration phenate, petroleum or constructional system sulfonate, salicylate, etc. have been used. In order to realize low ash and low sulfur which are the features of this invention and to maintain an elevated-temperature detergency, . As a metal system cleaning agent, the degree of formation of ** persalt basis with small ** sulfur content is not so high. ** It is desirable to use a metal system cleaning agent with description with an expectable (for example, amine reactant) base number more than the base number originating in ** metal containing metal (for example, order of Li from the more advantageous one, Mg, Ca, and Ba) with a small atomic number as a metallic component.

[0026] Metal salicylate is the alkali metal salt or alkaline earth metal salt of alkyl salicylic acid in which the number of average carbon atoms is usually manufactured using Kolbe Schmitt reaction from the alkylphenol obtained at the reaction of about eight to 30 alpha olefin and phenol. Alkaline earth metal salt usually converts Na salt or K salt into Ca salt and Mg salt by double decomposition method or a sulfuric acid part solution. Since residual chlorine of the double decomposition method using a calcium chloride (CaCl_2) etc. increases in number, it is not preferred at the point. Although alkylphenol is neutralized directly, it is made Ca salt and there is also a method of obtaining calcium salicylate directly at a carbonation process, the conversion rate to salicylate is inferior compared with the Kolbe Schmidt method. Therefore, the total basicity of alkyl salicylate (alkali metal salt or alkaline earth metal salt), the sulfuration of 30 - 300 mgKOH/g (still more preferably 30 - 100 mgKOH/g), manufactured through a Kolbe Schmidt method-sulfuric acid part solution is preferred.

[0027] The alkali metal salt or alkaline earth metal salt of organic acid or a phenol derivative which has carbon-nitrogen combination is also effective in this invention as a metal system cleaning agent. By making an amine compound react generally, the base number originating in basic nitrogen is obtained, a high base number is obtained and low ash also becomes advantageous. For example, although various things, such as metal salt of aminocarboxylic acid, can be considered, alkyl phenate (alkali metal salt or alkaline earth metal salt), the sulfuration which has Mannich base structure, is effective. Usually this compound is compounded by a Mannich reaction, neutralizes the reactant obtained by aminomethylation of the ring of phenol by bases, such as calcium hydroxide, using alkylphenol, formaldehyde, amine, or an amine compound, and is obtained by using metal salt. Specifically, the compound (R is an alkyl group with 8-30 carbon atoms, and n is 0 or a positive integer) expressed with a following general formula, for example is effective.

[0028]

[Formula 1]



[0029]As an example of the description of the compound of the above-mentioned general formula, Ca=2.5 % of the weight and N= 1.6% of the weight, there is a thing of total basicity =135 mgKOH/g and the base number originating in basic nitrogen shows about 50% of the total basicity.

[0030]Besides the metal system cleaning agent described so far, the sulfonate which is the alkali metal salt or alkaline earth metal salt of petroleum sulfonic acid, alkylbenzene sulfonic acid, or alkyloxy benzenesulfonic acid is used advantageously. When sulfuric acid ash is fixed from the field of an elevated-temperature detergency, sulfonate with the small degree of persalt group value is advantageous. However, since the addition of sulfonate with the small degree of persalt group value increases, and it makes a sulfur content increase and the total basicity does not become large considering an addition, as for this point, cautions are required. It is effective if it combines with salicylate [sulfuration] and a phenate derivative which were described previously.

[0031]The sulfuration phenate used conventionally is the alkali metal salt or alkaline earth metal salt of sulfuration alkylphenol, and Ca salt or Mg salt is usually known. Although sulfuration phenate has good heat resistance, the sulfur content resulting from a sulfuration reaction exceeds [many] about 3 % of the weight. In this invention, it can use selectively combining a metal system cleaning agent which was mentioned above. It is effective if it uses especially combining salicylate [sulfuration].

[0032]A metal system cleaning agent known as one of the typical ingredients of lubricating oil additive is an oily dispersed matter which contains organic acid metal salt (generally called a part for a part for soap, and soap), and basic mineral salt particles (an example, a calcium carbonate particle) condensed around the organic acid metal salt by a dispersion state in base oil. If abundance of organic acid metal salt is maintained more than a constant level even if it reduces an addition of a metal content cleaning agent to a lubricating oil composition, it turns out that there are few falls of the elevated-temperature detergency (performance which maintains an engine interior purely under hot environments) of the lubricating oil composition. In this invention, organic acid metal salt in a metal system cleaning agent exists in 0.2 to 7% of the weight of the range in a constituent, and exists in 0.4 to 3% of the weight of the range preferably.

[0033]c) Although dialkyl phosphorodithioate zinc is used in 0.01 to 0.1% of the weight of the range with a phosphorus content reduced property in a lubricating oil composition of dialkyl phosphorodithioate zinc this invention, it is preferred to be used from a viewpoint of a low phosphorus content and a low-sulfur content in quantity of 0.01 to 0.08% of the weight of a range.

[0034]As for dialkyl phosphorodithioate zinc, it is desirable to have an alkyl group with 3-18 carbon atoms. It is dialkyl phosphorodithioate zinc which contains the second class alkyl group derived from secondary alcohol with 3-18 carbon atoms from a field of prevention from wear. On the other hand, dialkyl phosphorodithioate zinc containing a first-class alkyl group derived from primary alcohol with 3-18 carbon atoms tends to be excellent in heat resistance. These dithiophosphate zinc may be used with a mixture which may use independently or makes a subject a second class alkyl group type thing and/or a first-class alkyl group type thing. Dialkyl aryl dithiophosphate zinc (for example, dialkyl aryl dithiophosphate zinc derived from dodecylphenol) can also be used if needed. In a lubricating oil composition with few sulfuric acid ash contents, although an increase in JICHIORRIN acid zinc leads to improvement in abrasion preventing performance, it is one side, and it may lead to a fall of an elevated-temperature detergency, and there is a problem of making not only phosphorus content but a sulfuric acid ash

content and a sulfur content increase.

[0035]In a lubricating oil composition of Lynn content ester this invention, d) Phosphoric ester, At least one kind of Lynn content ester chosen from a group which consists of thiophosphoric ester, dithiophosphate ester, and phosphite is used in 0.002 to 0.05% of the weight of the range with a phosphorus content reduced property. It is preferred to be used from a viewpoint of a low phosphorus content and a low-sulfur content in quantity of 0.002 to 0.03% of the weight of a range.

[0036]As for each of these Lynn content ester, it is preferred from a point of coexistence of an elevated-temperature detergency and abrasion preventing performance that it is triester. Generally, the number of carbon atoms (the number of average carbon atoms) is trialkyl phosphate, thiophosphoric acid triester, and phosphorous acid triester which have about three to 30 an alkyl group, an alkenyl group, an aryl group (especially phenyl group), an alkyl aryl group, or an arylated alkyl group. Diester and alkyl-acid-phosphate amine salt tend to be inferior in an elevated-temperature detergency, and metaled (especially lead) corrosion may generate them by a case.

[0037]As an example of such phosphoric ester aliphatic phosphate ester, for example, triisopropyl phosphate, Tributyl phosphate, ethyldibutyl phosphate, trihexyl phosphate, Tri-2-ethylhexyl phosphate, trilauryl phosphate, Triste allyl phosphate and trio rail phosphate; and aromatic phosphoric ester, For example, benzylphenyl phosphate, allyldiphenyl phosphate, Triphenyl phosphate, tricresyl phosphate, ethyldiphenyl phosphate, Cresyl diphenyl phosphate, dicresyl phenyl phosphate, Ethylphenyldiphenyl phosphate, diethylphenylphenyl phosphate, Propylphenyldiphenyl phosphate, dipropylphenylphenyl phosphate, Triethylphenyl phosphate, TORIPURO pill phenyl phosphate, buthylphenyl diphenyl phosphate, dibutylphenylphenyl phosphate, and tributylphenyl phosphate can be mentioned.

[0038]As an example of thiophosphoric ester, aliphatic series thiophosphoric ester, for example, triisopropyl thio phosphate, Tributylthio phosphate, ethyldibutylthio phosphate, trihexyl thio phosphate, Tri-2-ethylhexyl thio phosphate, TORIRAURIRU thio phosphate, Triste arylthio phosphate and TORIORE yl thio phosphate; and aromatic thiophosphoric ester, For example, benzyl phenylthio phosphate, allyldiphenylthio phosphate, Triphenylthio phosphate, TORIKUREJIRU thio phosphate, ethyldiphenylthio phosphate, Cresyl diphenylthio phosphate, JIKUREJIRU phenylthio phosphate, Ethyl FENIRUJI phenylthio phosphate, diethylphenyl phenylthio phosphate, Propyl FENIRUJI phenylthio phosphate, dipropylphenyl phenylthio phosphate, Triethyl phenylthio phosphate, TORIPURO pill phenylthio phosphate, buthylphenyl diphenylthio phosphate, dibutylphenyl phenylthio phosphate, and tributyl phenylthio phosphate can be mentioned.

[0039]As an example of dithiophosphate ester, dodecylphenyl dithiophosphate phenylethyl ester and dioctyl dithiophosphate phenylethyl ester can be mentioned.

[0040]As an example of phosphite, aliphatic series phosphite, for example, triisopropyl phosphite, Tributyl phosphite, ethyldibutyl phosphite, trihexyl phosphite, Tri-2-ethylhexyl phosphite, trilauryl phosphite, Tristearylphosphite and trioylel phosphite; and aromatic phosphite, For example, benzylphenyl phosphite, allyldiphenyl phosphite, Triphenyl phosphite, tricresyl phosphite, ethyldiphenyl phosphite, Tributyl phosphite, ethyldibutyl phosphite, cresyl diphenyl phosphite, JIKUREJIRU phenyl phosphite, ethylphenyldiphenyl phosphite, Diethylphenylphenyl phosphite, propylphenyldiphenyl phosphite, Dipropylphenylphenyl phosphite, triethylphenyl phosphite, TORIPURO pill phenyl phosphite, buthylphenyl diphenyl phosphite, dibutylphenylphenyl phosphite, and tributylphenyl phosphite can be mentioned. These Lynn content ester may be used alone, or may be used combining two or more kinds.

[0041]this invention person found out that abrasion preventing performance could be raised, maintaining an elevated-temperature detergency which was excellent without making a sulfuric acid ash content increase by using it for a lubricating oil composition combining the Lynn content ester which does not contain a part for metal in the above-mentioned dialkyl phosphorodithioate zinc. A ratio of dialkyl phosphorodithioate zinc and Lynn content ester is in the range of 20:1-1:1 by a phosphorus content ratio (weight ratio of the former versus the latter), and is in the range of 10:1-2:1 preferably.

[0042]e) At least one kind of compound chosen from a group which consists of a phenolic compound, an amine compound, and a molybdenum compound as an antioxidant is used for a lubricating oil composition of antioxidant this invention in 0.01 to 5% of the weight of the range. Generally, low ash, low phosphorus, and a low-sulfur lubricating oil composition mean reduction of a metal system cleaning agent and dithiophosphate zinc, and lead to a fall of an elevated-temperature detergency, oxidation stability, or wear tightness. An antioxidant is needed in order to maintain such performances. Usually, a hindered phenolic antioxidant and/or a diarylamine system antioxidant are used. These antioxidants are effective also for improvement in an elevated-temperature detergency. Since especially a diarylamine system antioxidant has a base number originating in nitrogen, it is advantageous at this point. On the other hand, a hindered phenolic antioxidant is advantageous to prevention of NO_x oxidation degradation.

[0043]As an example of a hindered phenol oxidation inhibitor, 2,6-di-*t*-butyl-*p*-cresol, 4,4'-methylenebis (2,6-di-*t*-butylphenol), 4,4'-methylenebis (6-*t*-butyl-*o*-cresol), a 4,4'-isopropylidenebis (2,6-di-*t*-butylphenol), A 4,4'-screw (2,6-di-*t*-butylphenol), 2,2'-methylenebis (4-methyl-6-*t*-butylphenol), 4,4'-Thiobis (2-methyl-6-*t*-butylphenol), a 2,2-thio-diethylenescrew [3-(3,5-di-*t*-butyl-4-hydroxyphenyl) propionate] And 3-(3,5-di-*t*-butyl-4-hydroxyphenyl) propionic acid octyl, Hindered phenols, such as 3-(3,5-di-*t*-butyl-4-hydroxyphenyl) propionic acid octadecyl and 3-(5-*t*-butyl-4-hydroxy-3-methylphenyl) propionic acid octyl, can be mentioned.

[0044]The number of carbon atoms as an example of a diarylamine antioxidant Mixed alkyl diphenylamine of 4-9, Diarylamines, such as *p,p'*-dioctyldiphenylamine, phenyl- α -naphthylamine, phenyl- β -naphthylamine, alkylation- α -naphthylamine, and alkylation-phenyl- α -naphthylamine, can be mentioned. A hindered phenol oxidation inhibitor and a diarylamine system antioxidant are used combining by request, although it can be used alone, respectively. Oil-soluble antioxidants other than these may be used together.

[0045]A molybdenum content compound belonging to a various functions type additive agent is also preferably used as an antioxidant. As for a molybdenum content compound, it is preferred to be contained in the range of 30 - 1000 weight ppm with a molybdenum content reduced property.

[0046]As a molybdenum content compound, imide, amide, or a molybdenum content reactant of amine is mentioned. A oxymolybdenum amber acid imide complex compound (JP,3-22438,B statement) containing sulfur is effective also for improvement in an elevated-temperature detergency or antioxidizing nature, and can be used conveniently. Oxymolybdenum sulfide dithiocarbamate and oxymolybdenum sulfide dithiophosphate are also effective in antioxidizing, prevention from wear, coefficient-of-friction reduction, etc.

[0047][Other additive agents] Addition of an alkaline metal borate salt hydrate is also still more effective for a lubricating oil composition of this invention in respect of grant of an elevated-temperature detergency or a base number. Especially an alkaline metal borate salt hydrate can be contained 0.01 to 5% of the weight 5 or less % of the weight. Although an alkaline metal borate salt hydrate has many things containing ash or sulfur content, taking into consideration description of the whole lubricating oil composition of this invention, it can adjust an addition and can use it effectively.

[0048]An alkaline metal borate salt hydrate as used in the field of this invention expresses a compound represented by compound compounded by U.S. Pat. No. 3929650 and a method of the No. [4089790] statement. For example, carbonate an alkaline metal or alkaline-earth-metals neutral sulfonate under existence of alkali metal hydroxide, and persalt group nature sulfonate is obtained, A particle dispersing element (it is desirable at the time of a carbonation reaction making ash-free nature powder medicine like amber acid imide live together) of alkaline metal borate salt produced by making boric acid react to this can be mentioned. As an alkaline metal, potassium, sodium, etc. are desirable here. A particle dispersing element with a particle diameter of about 0.3 micrometer or less expressed with empirical formula: KB_3O_5 and H_2O which neutral calcium sulfonate and an amber acid imide system were made to distribute as an example can be mentioned. From a waterproof point, what replaced potassium with sodium is used good.

[0049]As for a lubricating oil composition of this invention, it is still more desirable to include a viscosity index improver in 20 or less (preferably 1 to 20% of the weight of range) % of the weight of quantity. As an example of a viscosity index improver, high molecular compounds, such as poly alkyl methacrylate, ethylene propylene rubber, a styrene butadiene copolymer, and polyisoprene, can be mentioned. Or a distributed viscosity index improver or a various functions type viscosity index improver which gave dispersion performance to these high molecular compounds can be used. Although these viscosity index improvers can be used independently, arbitrary viscosity index improvers may be used combining two or more sorts.

[0050]A lubricating oil composition of this invention may contain various kinds of auxiliary additive agents further. As an example of such an auxiliary additive agent, as an antioxidant or an antiwear agent, Zinc dithiocarbamate, methylenebis (dibuthyldithiocarbamate), an oil-soluble copper compound, a sulfur-systems compound (an example, olefin sulfide, ester sulfide, polysulfide), an organic amide compound (an example, oleylamide), etc. can be mentioned. Compounds which function as metal deactivator, such as a benzotriazol system compound and a thiadiazole system compound, can also be added. Polyoxyalkylene nonionic surface-active agents, such as a copolymer etc. of polyoxyethylene alkyl phenyl ether and ethylene oxide which function as a rust-proofer or a demulsifier, and propylene oxide, can also be added. Various amine and amide which function as a friction modifier, amine salt and those derivatives, fatty acid ester of polyhydric alcohol, or those derivatives can also be added. Various compounds which function as a defoaming agent or pour point depressant can also be added further again. As for these auxiliary additive agents, it is desirable to use it to a lubricating oil composition in 3 or less (especially 0.001 to 3% of the weight of range) % of the weight of quantity, respectively.

[0051]

[Example](1) The lubricating oil composition according to manufacture this invention of a lubricating oil composition and the lubricating oil composition for comparison were manufactured using a following additive component and base oil ingredient. By addition of the viscosity index improver, these lubricating oil compositions (engine oil) were prepared so that the viscosity grade (SAE viscosity grade) of 5W30 might be shown.

[0052](2) An additive agent and the base oil dispersing agent 1 : boron content amber acid imide system dispersing agent (nitrogen content: 1.5% of the weight) Boron content : a number average molecular weight the polyisobutenyl amber acid anhydride produced by making the highly reactive polyisobutene (at least about 50% has methylvinylidene structure) and the maleic anhydride of about 1300 react by a thermal reaction method less than chlorine content:5 weight ppm 0.5% of the weight, What carried out reaction processing of the screw type amber acid imide which made react to polyalkylene polyamine of the number of average nitrogen atoms of 6.5 pieces (per molecule), and was subsequently obtained with boric acid

[0053]Dispersing agent 2: Ethylene carbonate reaction processing amber acid imide system dispersing agent (nitrogen content: 0.85% of the weight) Chlorine content : the polyisobutenyl amber acid anhydride produced by making 30 weight ppm, and the highly reactive polyisobutene (at least about 50% has methylvinylidene structure) and the maleic anhydride of the number average molecular weight 2300 [about] react by a thermal reaction method, What carried out reaction processing of the screw type amber acid imide which made react to polyalkylene polyamine of the number of average nitrogen atoms of 6.5 pieces (per molecule), and was subsequently obtained with ethylene carbonate

[0054]Cleaning agent 1: Calcium sulfide phenate (Ca: 9.3-% of the weight, S:3.4-% of the weight, TBN:255 mgKOH/g, and Chevron Texaco Japan OLOA219)

Cleaning agent 2: Calcium sulfonate (Ca: 2.4-% of the weight, S:2.9-% of the weight, TBN:17 mgKOH/g, and Chevron Texaco Japan OLOA246S)

[0055]ZnDTP1: Dialkyl phosphorodithioate zinc (P:7.2 % of the weight, Zn: use secondary alcohol with 3-8 carbon atoms as a raw material 7.85 % of the weight and S:14% of the weight)

ZnDTP2: Dialkyl phosphorodithioate zinc (P:7.3 % of the weight, Zn: use primary alcohol with eight carbon atoms as a raw material 8.4 % of the weight and S:14% of the weight)

[0056]Phosphate 1: Tricresyl phosphate (P:8.4 % of the weight)

Phosphate 2: Tris [Alkyl (carbon number 1-3)-phenyl] Phosphate (P:7.3 % of the weight)

Phosphite 1: Tricresyl phosphite (P:8.8 % of the weight)

Phosphite 2: Trilauryl phosphite (P:5.3 % of the weight)

Thio phosphate: Triphenylthio phosphate (P:9.0 % of the weight, S:9.4 % of the weight)

[0057]Antioxidant 1: Amine compound [Dialkyl diphenylamine (alkyl group: mixing of C₄ and C₈),

N:4.6 % of the weight, TBN:180 mgKOH/g]

Antioxidant 2: Phenolic compound [3-(3,5-di-t-butyl-4-hydroxyphenyl) propionic acid octyl]

Antioxidant 3: Molybdenum compound (a oxymolybdenum amber acid-imide complex compound, Mo containing sulfur: 5.4 % of the weight, S:3.7 % of the weight, TBN:45 mgKOH/g)

Antioxidant 4: Molybdenum compound [Oxymolybdenum sulfide dithiocarbamate (alkyl group: mixing of the first-class alkyl of C₈ and C₁₃), Mo:4.5 % of the weight, S:4.7 % of the weight]

[0058]viscosity index improver (VII) — ethylene propylene copolymer pour-point-depressant

[of non-distributed type] (PPD): — a polymethacrylate system compound [0059]base oil: — **

hydrocracking mineral oil (kinetic viscosity [of 100 **]: — 4.1mm²/s.) Viscosity index : 127, evaporation-loss (ASTM D5800):15 % of the weight, sulfur content: — less than 0.001-% of the weight, aromatic content:8 % of the weight, and ** solvent refining mineral oil (kinetic viscosity

[of 100 **]: — 4.4mm²/s.) Viscosity index : 101, evaporation-loss:23 % of the weight, sulfur content:0.14 % of the weight, aromatic content: — 32 % of the weight and ** solvent refining

mineral oil (kinetic viscosity [of 100 **]: — 7.5mm²/s.) Viscosity index: The mixed oil of the weight ratio 50:35:15 which consists of 95, evaporation-loss:6 % of the weight, sulfur content:0.20 % of the weight, and aromatic content:35 % of the weight (sulfur content: 0.08 % of the weight)

[0060](3) With the measurement usual rubber membrane dialysis of the organic-acid-metal-salt content (a part for soap), a part for mineral oil and the low molecular weight constituent in a metal system cleaning agent were dialyzed, and the weight of the dialysis residue (A) which is a cleaning agent active principle which remains in rubber membrane was measured. On the other hand, the carbon dioxide originating in carbonate in a metal content cleaning agent was measured, and the weight of persalt group nature ingredients (B), such as calcium carbonate or magnesium carbonate, was found based on this and metal analysis. The content of organic acid metal salt (a part for soap) was calculated from the difference of this weight of (A) and (B).

[0061](4) The evaluation shell walk examination of the abrasion preventing performance of a lubricating oil composition was carried out as follows, and the abrasion preventing performance of the lubricating oil composition was evaluated. After loading a shell walk testing machine with sample oil, the testing machine was operated for 30 minutes at the sample oil temperature of 90 **, the load of 30 kg, and the number of rotations of 1800 rpm. The pitch diameter of the abrasion was measured after the examination.

[0062](5) The evaluation hot tube examination (KES-07-803) of the elevated-temperature detergency of a lubricating oil composition was carried out as follows, and the clarification performance in the elevated temperature of a lubricating oil composition was evaluated. A glass tube 2 mm in inside diameter was vertically set to the heater block, sample oil was sent in in 0.31cc/[an hour and], and air was sent in from the lower part of the glass tube at 10-cc a rate for /, respectively. This operation was continued for 16 hours, keeping the temperature of a heater part at 280 **. After test termination, ten-point full marks estimated the deposit (sediment) adhering to the inside of a glass tube (ten points mean the state where there is no deposition of a deposit).

[0063][Example 1] Combination (1) ash-free nature powder medicine of the lubricant composition of this invention: Dispersing agent 1 (addition: 2.1 % of the weight, nitrogen volume conversion addition:0.031 % of the weight)

Dispersing agent 2 (addition: 7.0 % of the weight, nitrogen volume conversion addition:0.06 % of the weight)

(2) Metal content cleaning agent : cleaning agent 1 (addition: 0.74 % of the weight, sulfuric acid ash conversion addition:0.23 % of the weight, organic-acid-metal-salt conversion addition:0.3 % of the weight)

Cleaning agent 2 (addition: 0.85 % of the weight, sulfuric acid ash conversion addition:0.07 % of

the weight, organic-acid-metal-salt conversion addition:0.4 % of the weight)

(3) Dialkyl phosphorodithioate zinc : ZnDTP1 (addition: 0.69 % of the weight, phosphorus pool conversion addition:0.050 % of the weight)

ZnDTP2 (addition: 0.33 % of the weight, phosphorus pool conversion addition:0.024 % of the weight)

(4) Lynn content ester : phosphate 1 (addition: 0.27 % of the weight, phosphorus pool conversion addition:0.023 % of the weight)

(5) Antioxidant antioxidant 1 (addition: 0.3 % of the weight)

Antioxidant 2 (addition: 0.2 % of the weight)

Antioxidant 3 (addition: 0.2 % of the weight)

Antioxidant 4 (addition: 0.2 % of the weight)

(6) Other additive agent viscosity index improvers (addition: 6.1 % of the weight)

pour point depressant (addition: 0.3 % of the weight)

(7) base oil (the amount used: 80.72 % of the weight)

[0064][Example 2] — combination (4) Lynn content ester [of the lubricant composition of this invention]: — phosphate 2 (addition: 0.32 % of the weight, phosphorus pool conversion addition:0.023 % of the weight)

It was alike, and changed and the lubricating oil composition was prepared by the same combination as Example 1 except having used base oil (the amount used: 80.67 % of the weight).

[0065][Example 3] — combination (4) Lynn content ester [of the lubricant composition of this invention]: — phosphite 1 (addition: 0.26 % of the weight, phosphorus pool conversion addition:0.023 % of the weight)

It was alike, and changed and the lubricating oil composition was prepared by the same combination as Example 1 except having used base oil (the amount used: 80.73 % of the weight).

[0066][Example 4] — combination (4) Lynn content ester [of the lubricant composition of this invention]: — phosphite 2 (addition: 0.43 % of the weight, phosphorus pool conversion addition:0.023 % of the weight)

It was alike, and changed and the lubricating oil composition was prepared by the same combination as Example 1 except having used base oil (the amount used: 80.56 % of the weight).

[0067][Example 5] — combination (4) Lynn content ester [of the lubricant composition of this invention]: — thio phosphate (addition: 0.26 % of the weight, phosphorus pool conversion addition:0.023 % of the weight)

It was alike, and changed and the lubricating oil composition was prepared by the same combination as Example 1 except having used base oil (the amount used: 80.73 % of the weight).

[0068][The comparative example 1] Combination (4) Lynn content ester of the lubricant composition for comparison: It changed intact and the lubricating oil composition was prepared by the same combination as Example 1 except having used base oil (the amount used: 80.99 % of the weight).

[0069]

[Table 1]

評価試験結果

	実施例 1	実施例 2	実施例 3	実施例 4	実施例 5	比較例 1
〔試験油組成〕 (wt.%)						
分散剤 1 窒素量	0.031	0.031	0.031	0.031	0.031	0.031
分散剤 2 窒素量	0.060	0.060	0.060	0.060	0.060	0.060
清浄剤 1 硫酸灰分	0.23	0.23	0.23	0.23	0.23	0.23
清浄剤 2 硫酸灰分	0.07	0.07	0.07	0.07	0.07	0.07
ZnDTP1 リン量	0.050	0.050	0.050	0.050	0.050	0.050
ZnDTP2 リン量	0.024	0.024	0.024	0.024	0.024	0.024
アリフェート1 リン量	0.023	—	—	—	—	—
アリフェート2 リン量	—	0.023	—	—	—	—
アリフェート1 リン量	—	—	0.023	—	—	—
アリフェート2 リン量	—	—	—	0.023	—	—
アリフェート リン量	—	—	—	—	0.023	—
酸化防止剤 1	0.3	0.3	0.3	0.3	0.3	0.3
酸化防止剤 2	0.2	0.2	0.2	0.2	0.2	0.2
酸化防止剤 3	0.2	0.2	0.2	0.2	0.2	0.2
酸化防止剤 4	0.2	0.2	0.2	0.2	0.2	0.2
V I I	6.1	6.1	6.1	6.1	6.1	6.1
PPD	0.3	0.3	0.3	0.3	0.3	0.3
〔性状〕						
SAE粘度グレード	5W30	5W30	5W30	5W30	5W30	5W30
硫酸灰分 (wt.%)	0.49	0.49	0.49	0.49	0.49	0.49
リン含量 (wt.%)	0.097	0.097	0.097	0.097	0.097	0.074
硫黄含量 (wt.%)	0.30	0.30	0.30	0.30	0.32	0.30
塩素含量 (wt.ppm)	<5	<5	<5	<5	<5	<5
石炭分 (wt.%)	0.7	0.7	0.7	0.7	0.7	0.7
(ZnDTP1+ZnDTP2) : リン含有量 (質量比)	3.2:1	3.2:1	3.2:1	3.2:1	3.2:1	—
〔シェール四球試験〕						
平均摩耗痕径 (mm)	0.43	0.40	0.45	0.44	0.37	0.53
〔ホットチューブ試験〕						
評点	7.0	7.0	7.0	7.0	7.0	7.0

[0070] So that clearly from the above-mentioned evaluation test result Dialkylphosphorodithioate zinc and phosphoric ester, Each lubricating oil composition (examples 1-5) of this invention which added thiophosphoric ester or phosphite by the specific ratio is compared with the lubricating oil composition (comparative example 1) which added only dialkyl phosphorodithioate zinc, Abrasion preventing performance improved notably, maintaining the elevated-temperature detergency of an equivalent high level without making a sulfuric acid ash content increase.

[0071]

[Effect of the Invention] Although the lubricating oil compositions of this invention are a low sulfuric acid ash content, a low phosphorus content, and a low-sulfur content, they show the outstanding elevated-temperature detergency and abrasion preventing performance. Therefore, the car by which, as for the lubricating oil composition of this invention, a sulfur content uses about 0.01 or less % of the weight of hydrocarbon system fuel as fuel for a run, It can use conveniently for the diesel-power-plant loading car especially provided with the emission gas purge (especially a particulate filter and an oxidation catalyst, or a reduction catalyst).

[Translation done.]